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ABSTRACT

This study reviews literature on the education of teachers, lawyers, engineers, and other professions, providing comparison of the nature of expertise in the various professions and on how it is acquired. Four definitions of expertise are presented--expertise as technical skill; expertise as application of theory; expertise as critical analysis; and expertise as deliberate action--with illustrations showing how these types of expertise are seen in the teaching profession. The meanings and implications of these kinds of expertise for teaching practice are examined, and current methods of fostering expertise are delineated. A nine-page reference list is included. (Author/CB)

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INEXACT SCIENCES: PROFESSIONAL EDUCATION AND THE DEVELOPMENT OF EXPERTISE

Mary M. Kennedy

NCRTE

National Center for Research on Teacher Education

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Abstract

This paper reviews literature on the education of teachers, lawyers, engineers, and other professions. The author identifies four kinds of expertise which professional educators try to foster: technical skills, knowledge of general principles, the ability to engage in critical analysis, and the ability to engage in deliberate action. The meanings and implications of these kinds of expertise for practice are examined, and current methods of fostering expertise are delineated.

INEXACT SCIENCES: PROFESSIONAL EDUCATION AND THE DEVELOPMENT OF EXPERTISE[1]

Mary M. Kennedy[2]

Professionals contribute to society in a variety of ways. They design buildings and bridges that will serve their clients' purposes, prescribe drugs or perform surgery designed to rectify their patients' physical ailments or to make them more comfortable, decide what content to teach students and how to teach it, and defend clients. They share in common the ability to connect solutions to problems. And they are assumed to possess special expertise that enables them to do this.

In this paper, I review literature on the nature of expertise and on how it is acquired. To do justice to the issues, I include important nonempirical, as well as empirical, literature. I also include empirical studies drawn from outside professional education literature, particularly from cognitive psychology. I review four definitions of expertise, each of which incorporates a different view about how expertise influences professional actions: expertise as technical skill, as application of theory, as critical analysis, and as deliberate action. Each succeeding definition remedies failures of earlier definitions, and in so doing each defines expertise as a more complicated phenomenon than its predecessor. But in the end, each definition is incomplete in some critical way.

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expressed outside professional education circles, which I allude to occasionally with the help of Moliere. The view pervades sociological literature of professional education and pervades lay literature as well. It is not a new view; it is expressed repeatedly in Moliere's plays. For instance, in The Imaginary Invalid, the character Beralde suggests that his brother become a doctor. When the brother protests that he is too ignorant, Beralde responds, "Once you put on the cap and gown of a doctor the rest comes of itself. You'll find you have all the skill you require. . . . Whatever nonsense you talk becomes wisdom and all that rubbish, good sense."

Expertise as Technical Skill

The first definition of expertise derives from the specific tasks a professional must perform. The architect draws, the teacher disciplines children, the engineer constructs models and calculates stress. Most professional programs do teach specific skills, and they tend to do it army-style: Teachers explain, then demonstrate; students execute under supervision, then without supervision; and teachers examine performance (McGlothlin, 1960).

Teacher education has a particularly strong history of efforts to define teaching expertise on the basis of the technical tasks of teaching. An early example of such an effort was undertaken by Charters and Waples (1929). These researchers identified several hundred discrete teaching tasks, and then asked practicing teachers to rank the tasks according to (a) how frequently the teachers performed the task, (b) how difficult the task was, (c) how important the task was, and (d) whether

the task should be taught in teacher education programs. The tasks listed in the questionnaire ranged from such trivial matters as "sending students on errands" to such important matters as "adapting a curriculum for the particular learners in the classroom." It took participating teachers nine hours to complete this form.

Not surprisingly, teachers were more likely to identify as difficult such tasks as adapting the curriculum to the particular learners in the classroom. Indeed, this "task" involves more than technique. It requires a complex judgement based on such varied considerations as the teacher's understanding of the content being taught, how that content is represented in the curriculum, how it may be represented in examinations students must take, how it can be represented for instruction, and how the students are likely to perceive it. There are myriad ways in which a curriculum could be adapted, and the "best" way depends on the pattern of all these particulars, and that particular pattern cannot be imparted to teachers when they are still students themselves.

A related but more recent effort to define teaching expertise by the tasks of teaching is the Competency-Based Teacher Education (CBTE) movement. The logic of CBTE is the same as that of Charters and Waples: Teaching expertise can be broken down into discrete units; each unit can be defined as an observable behavior; and each unit can be taught to prospective teachers independent of the other.

The ideal CBTE program is built upon learning modules. Each module includes a rationale for why the competency is important, a list of learning objectives, a list of learning experiences the prospective

teacher will engage in to learn the competency, and an assessment of the teacher's competence (Hall and Jones, 1976). If teachers can demonstrate competence prior to doing the exercises in the module, they can skip over it. If they fail the competency test at the end, they must repeat it (Haberman and Stinnett, 1973). The technical-skills view of expertise rest on three important assumptions. It assumes that the constituent skills can be identified, that the skills can be transmitted to prospective practitioners, and that they can be appropriately drawn upon in practice.

It has proved to be easy to identify competencies, but it has not been easy to delimit their number or to establish agreement on the list. In the late 1960s, when the U. S. Department of Education sponsored the development of several models for competency-based teacher education (Burdin and Lanzilotti, 1969), it produced very different views of what the competencies were. One model CBTE program described teacher competencies in terms of teacher roles rather than teaching tasks, using theory rather than task analysis to derive competencies (Joyce, 1969). Others relied on the tasks of teaching (Dodl, 1969); Shalock, 1969). Further, as lists incorporated more complex competencies, confidence of what contributed to the competencies became weaker. Eventually the approach came to be criticized for its proliferation of competencies, for its inability to validate competencies, and for its narrow instrumental view of teaching (Short, 1985; Sykes, 1984). Some authors (eg., Evertson, Hawley, and Zlotnik, 1984) think the notion may eventually be revived as research on teaching provides the necessary validation of competencies.

With regard to how technical skills are transmitted, research on

microteaching (Gage, 1977; Haberman and Stinnett, 1973; Peck and Tucker, 1973) indicates that teaching tasks can indeed be taught to student teachers, though microteaching alone is not sufficient to assure transfer to the classroom. Research in other professions also indicates that technical skills can be taught (Dinham and Stritter, 1986). In their review of research on teaching skills, Joyce and Showers (1980) identified four levels of impact which training programs may have--awareness of the importance of an area, knowledge about it, acquisition of skills, and finally application of skills in the context of practice. They also identified an array of training components which map easily against these outcomes. Presenting theory increases student awareness; modeling increases both awareness and knowledge; providing opportunities to practice with feedback enhances the skills themselves; and coaching for application in the classroom enables the student-teacher to transfer the new skill to practice.

The technical-skills definition of expertise has been most criticized for its assumptions about how technical skills contribute to professional practice. What the technical skills orientation lacks, at least in a pure form such as has been described here, is attention to the rest of professional expertise: theory and principles, analytic capacity, and so forth. It overlooks the decisions professionals make about <u>whether</u> and <u>when</u> to employ a particular skill. In a study of open education programs, Bussis, Chittenden, and Amarel (1976) found that teachers who knew technique but not rationale were unable to improvise. They could emulate their advisors and could introduce practices into the classroom that their advisors recommended, but when the advisors left the

room these teachers didn't know how to carry on by themselves. Those who had learned both rationale and technique "were able to move back and forth between classroom activities and organizing priorities, using a specific encounter to illustrate a broader concern and relating broader priorities back to specific concerns" (p. 61).

Definitions of expertise that focus on segments of observable behavior miss the intentionality of practice (Broudy, 1984). The attractive simplicity of the technical-skills view of expertise depends in part on its failure to consider the whole of professional practice. Skills without purpose can produce doctors such as Moliere's A Doctor In Spite of Himself, Sgannerelle, who announces, on being taken to a girl who appears to be dying, "She mustn't do anything of the kind. She mustn't die without a doctor's prescription."

Other professions have been attracted to technical-skills definitions of expertise, but have eventually become disabused of them. Sheahan (1980) describes recent trends in nursing education away from a task-analytic approach and toward what he calls the nursing process. In the late 1940s and early 1950s, Dougherty (1950) criticized engineering education for concentrating on technique and failing to provide the principles and concepts on which technique is based. His writings were extremely influential in the next several decades. During that period the American Society for Engineering Education formed two task forces to review the needs of prospective engineers, and each advocated a shift in emphasis from discrete technical skills toward general principles. By 1960, skills were virtually excluded from the engineering curriculum (McGlothlin, 1960).

Yet practitioners need both skills and principles. Recent assessments of engineering education indicate that the complete exclusion of technical skills from engineering programs leaves engineers unprepared for practice. The American Association of Engineering Educators found that industries complained that recent graduates "needed considerable extra training before they could undertake the experimental work of them" (Ernst, 1985-86, p. 165). Harrisberger (1985) points out that 80 percent of the contemporary engineering curriculum is comprised of the "ics"--physics, mathematics, dynamics, electronics; but that engineering practice consists of "ings": consulting, designing, planning, evaluating. He poses the rhetorical question, Should not a professional education program be prepared to certify that its graduates can competently perform the tasks of engineering?

Finding a proper role for technical skills in a definition of expertise is thus problematic. Emphasis on skills to the exclusion of other aspects of professional expertise may not facilitate practice. Yet exclusion of technical skills training may also fail to facilitate practice.

Expertise as The Application of Theory or General Principles

In Moliere's play, A Doctor in Spite of Himself, the character Martine tells this anecdote about a local doctor: "Not three weeks ago a young boy of twelve fell from the top of the church tower and smashed his head, arms, and legs on the road. They had no sooner called this [doctor] in than he rubbed him all over with a certain ointment he makes and the boy immediately got to his feet and ran off to play marbles."

Valere, the impressed listener, responds: "He must have the secret of the Universal Remedy."

Though contemporary professions do not aspire to the Universal Remedy, most do aspire to a theory or a body of general principles which could enable practitioners to treat particular cases as examples of categories about which something is known. Whether they have succeeded in a matter of general debate. Writers such as White (1986) have criticized professional journalism schools for inventing theories that are not really relevant to practice, simply to enhance the presumed intellectual underpinnings of the field.

A major influence on the professional school's desire for theory and general principles is its university setting. Universities tend to pressure professional schools to meet the rigorous standards of the disciplines (Guttman, 1985; Morehead, 1973; White, 1986; Jencks and Reisman, 1969), and critics of professional schools often expect them to embody the same kind of academic rigor that the university disciplines embody. A prominent example of such criticism is Koerner's (1963) critique of teacher education programs, which he argued were not rigorous, not intellectually defensible, and indeed were not even disciplines but instead lived on ideas borrowed from the disciplines. Implicit in criticisms such as this is the notion that professional education is not justifiably housed within a university unless it is based on rigorous theoretical or scientific principles such as those that characterize the disciplines.

But not all relevant principles derive from science. Professional practices can be guided by several kinds of principles: The disciplines

provide theoretical or scientific principles; experience provides admonitions such as "never smile before Christmas"; and social norms provide guidelines for appropriate ethical behavior (Shulman, 1986).

And not all professional programs succumb to pressures for scientific principles. Architecture has rejected scientific principles in favor of artistic impulse on at least two occasions in its history (Guttman, 1985). Early on, architecture schools provided education in both engineering and design concepts, but gradually came to deemphasize the former and to define the profession of architecture as a field specializing in design. More recently, after a long period of time during which architects derived functional principles of design from social science constructs, the field has rejected these constructs in favor of intuitive aesthetic principles of design. Guttman has argued that theoretical underpinnings can stifle the artistic intuition needed to design buildings and thus harm more than help the profession.

Aside from the intellectual prestige of theory and general principles, there are practical reasons for using them to define expertise. In the late 1950s, business education went through a soul-searching exercise similar to that which teacher education is now going through. It became apparent that business education could not provide the myriad of skills necessary for the variety of positions business graduates would assume. Consequently, business schools had two choices: They could provide graduates with the knowledge and skills needed for one or two positions, in the hope that other business schools would concentrate on other positions; or they could provide the broader principles on which practice was based--economics, marketing, or

organizational behavior--and assume graduates would learn their job-specific skills on the job. In 1959, two major assessments of business education were published (Gordon and Howell, 1959; Pierson, 1959), both of which argued for broader training and a movement away from specific skills of practice. Alonzo (1986) describes a similar decision on the part of professional planning schools, also based on the impossibility of preparing their students for the myriad positions they would take upon graduation.

But the most important reason for trying to develop such a base of theory and general principles is that professionals need to solve problems and make decisions in ambiguous situations. Programs that concentrate on theoretical or empirical knowledge offer students important advantages that skills-oriented programs cannot. Their students acquire a broader understanding of practice and of the rules of thumb that guide it. Expertise is expanded to include not just applying skills, but recognizing situations in which it is appropriate to do so.

Medical and engineering education programs most clearly exemplify this view of expertise. In these fields, principles are presented to students through their disciplinary origins. Medical students, for instance, take two years of courses in basic sciences--anatomy, physiology, pharmacology and so forth--followed by two years of clinical studies. Engineering students take a series of basic science courses--Harrisberger's "ics"--followed by an engineering design series where they learn to apply these concepts.

Until recently, the andragogical[3] implications of expertise-as-theory-or-general-principles have been assumed to be relatively straightforward. Theory and principles can be transmitted to students in much the same way that knowledge is traditionally conveyed in university settings: through lectures, group discussions, and assigned projects. But instruction in practice-relevant principles necessarily differs from the instruction provided in the arts and sciences courses, for it must enable students to apply these principles to real cases. One problem professional educators face is how to help students see the relationship between general principles and the particular situations they will encounter in practice; another is how to help students merge principles that derive from different disciplines but which may apply to the same case.

In regard to tying general principles to particular cases, Borrowman (1956) describes the tension as follows:

> There are two equally-to-be feared dangers in educational theorizing. One is that theory can become so far removed from real problems that it becomes meaningless in their solution; the second is that it becomes so closely tethered to immediate utility that perspective is lost. (p.22)

Programs that emphasize theory and principle have traditionally provided the relevant body of knowledge to students first, then followed up with some form of field experience designed to help students recognize real-world events as examples of these principles. The sequence has

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[3]Andragogy is the adult counterpart to pedagogy; it refers to the technique of teaching adults. It is not a common term in educational research. I use it here to emphasize that this is the task of professional education.

recently come under attack, however. Roberts (1985) and Morehead (1973) have suggested that education students may not see the relevance of theory until they have practiced and that early practical experience can improve students' appreciation for theory learned later on. In medicine, Walton (1985) chastises the "outmoded belief that clinical studies must be preceded by basic science teaching" (p. 47) and proposes a vertical integration of the curriculum, such that clinical and basic science studies occur simultaneously throughout medical school.

With regard to integrating the principles that derive from different disciplines, medical education has experienced several efforts over the past three decades to teach basic sciences in a more integrated way (Schofield, 1984). The most prominent example occurred at Case Western Reserve University, where courses were organized around the body organs, rather than around the disciplines. The method proved difficult, however, and often resulted in nothing more than disciplinary faculty taking turns presenting unrelated lectures. Gessner, Katz, and Schimpfhauser (1981) describe a method for providing integrated knowledge on health problems that are both social and medical, such as substance abuse and occupational health. They created special courses on each of these health problems, but students still took their basic science courses as well. The format for the new courses was altered from the traditional lecture to include more discussion and analysis of example problems.

This view of expertise assumes that theory and general principles can be applied to particular situations, and assumption which raises three questions. The first question has to do with how the practitioner

recognizes a particular case as an example of a general principle; the second with how the practitioner adjusts predictions derived from a general principle to accommodate the special features of the case; and the third with how practitioners blend the variety of potentially relevant principles to form an integrated body of knowledge that can be applied to specific cases.

The first question is raised because real cases do not present themselves as examples of general principles. Relevant identifying features are usually embedded in complex detail. Thus expertise is not merely the knowledge that general principles exist; it is the ability to recognize the cases to which they apply. In a landmark investigation of medical problem solving, Elstein, Shulman, and Sprafka (1978) examined the thought processes of physicians as they diagnosed patients. They used a variety of techniques to examine physician thinking and reasoning, including three high-fidelity simulations, in which actors played the role of patients and doctors were asked to think aloud as they diagnosed these patients. They found that physicians did engage in hypothesized activities such as seeking and evaluating cues and generating hypotheses. However, they also found that physicians generated hypotheses quite early in the clinical interview, before many data had been gathered; that only a few hypotheses were considered; and that new information was often used to assess existing hypotheses rather than to generate new hypotheses. Thus, if physicians do not generate the right hypothesis right away, they are unlikely to do so at all. Further, the diagnostic strategies used by physicians who were presumed to be experts were no different from those of other physicians.

The second question was whether or how practitioners should alter general principles to take into account the particular features of a case. Since most scientifically derived principles were probabilistic, even a correct diagnosis of the case as an example of a principle may not indicate that the principle should be applied to that particular case. Meehl (1977) provides an example of the kind of decision often facing clinical psychologists. The statistical prediction for Jones, based on age, sex, and performance on diagnostic instruments, suggests that Jones has a 75 percent chance of responding to therapy. The clinician cannot know whether Jones is one of the 75 percent who will respond. But he does know that Jones's mother sent him in, that Jones's tests indicated a problem with mother figures, and that the only therapist available is a stern woman. Should these facts alter the general principle? The "right" answer, of course, depends on which data are relevant to the success of the therapy, and that cannot be known in advance.

That real cases are multidimensional has also fostered debates about the extent to which general principles can or should be applied at all. Critics argue that such principles inhibit, rather than enhance, professional judgement by requiring practitioners to attend only to the particular variable mentioned in the principle. In the mid-fifties, Meehl (1954) listed the epithets wielded against the use of statistical predictions in clinical psychology as including "mechanical, atomistic, additive, cut and dried, artificial unreal, arbitrary, incomplete, dead, pedantic, fractionated, trivial, forced, static, superficial, rigid, sterile, academic, oversimplified, pseudoscientific, and blind" (p. 4).

A contemporary version of this same debate appears in teacher

education. In the past decade or so, research on teaching has produced several general principles about the relationship between teacher behaviors and student achievement (Brophy and Good, 1986; Evertson, Hawley, and Zlotnick, 1984; Smith, 1983). In objecting to this strategy of research, Zumwalt (1982) argues that these statements miss "the central core of teaching. The narrow view of learning and the fragmented view of teaching inherent in the process-product paradigm limit its usefulness as a guiding paradigm for teacher educators" (p. 234). Zumwalt argues that social situations are controlled by so many variables that unidimensional principles can rarely if ever guide action. Meehl responded to this argument in the context of clinical psychology in 1954 by pointing out that any decision, whether clinical or statistical, is predicated on an hypothesized caused-effect relationship, and that such an hypothesis can only be made by defining the situation as an example of some class of events where the cause-effect relationship obtains. The practitioner's multifaceted knowledge about particular cases does not invalidate general principles, it merely redefines a case into a narrower subclass of events on which the case-effect hypotheses are bases.

The issue is not simply one of <u>when</u> to apply principles; it is also one of <u>whether</u> individual decision makers are capable of making such judgments. Kahneman and Tversky (Kahneman, Slovic, and Tversky 1982) have conducted a considerable body of research on human judgement and decision making in relation to statistical predications, and have found several ways in which human judgments fail to comply with statistical rules of inference and estimation. For instance, when told that a sample of cases included 30 lawyers and 70 engineers (or vice versa) and asked

to judge individual occupations, research subjects relied on the extent to which cases fit stereotypes of lawyers or engineers, rather than on the statistical likelihood of membership in one class or the other (Tversky and Kahneman, 1982b). Research subjects also estimated probabilities on the basis of the vividness of their own images of events, rather than on the basis of empirical or reasoned estimation. If my uncle had recently died of emphysema, for instance, I might overestimate the frequency of death by emphysema (Tversky and Kahneman 1982a). Kahneman and Tversky (1982) interpret their data as evidence that clinical judgments are biased. But other researchers have argued that Tversky and Kahneman's tests misconstrue human judgement by measuring it against an a priori standard of rationality. Perhaps these judgments would be rational if viewed from the individual's perspective instead of an a priori criterion (Jungermann, 1986).

The third problem with applying general principles has to do with how the practitioner selects among multiple, competing principles that apply to one case. In education, for instance, general principles may be derived from the disciplines of psychology or sociology, or from empirical investigations of the relationship between teaching methods and student learning. But the guidance provided by one discipline may conflict with that provided by another. Thus, the view of good mathematics teaching which derives from cognitive psychology may suggest different teaching behaviors from those suggested by process-product research (Brophy, 1986a, 1986b; Confrey, 1986; Romberg and Carpenter, 1986). Preparing teachers by providing them with principles from an array of disciplines may not, therefore, help them decide what to do.

So the general-principles definition of expertise eventually stumbles on the same problem that beset expertise-as-technical-skill; principles provide rules of thumb intended to guide practice, but there are no rules of thumb for how to select the appropriate rule of thumb. Cases do not present themselves to practitioners as examples of general principles, but instead force practitioners to ferret the principles out from the case. Further, there are no rules for altering the general principle to take into account particular circumstances, and there are cases for which several equally plausible principles may apply, even though they suggest different actions, so that practitioners must decide which principle(s) will be applied and which will not. Finally, there is evidence that the heuristics human beings use to determine which principle applies, and to decide whether to apply it or to alter it, may be biased or inaccurate.

Most members of professional communities do not concern themselves with the fallibility of human judgments, but instead value both general principles and practitioners' insights. Pellagrino (1977) distinguishes medical science from medicine, the former being science and the latter being practice, and Gage (1977, 1985) refers to research findings as the "scientific basis of the art of teaching." He argues that practice is ultimately improved when science is used to guide practice, but that practice consists of artfully drawing on these principles to meet the special demands of each new situation. Whatever language is used to describe the application of general principles to particular cases, it is clear that the task is far from simple. It is also clear that if professional educators attend only to the principles, and not to the

heuristics that determine whether and when principles are applied, they may not facilitate future practice in the ways they think they will.

The Requirement That Expertise Be Prescriptive

The two definitions of expertise described above--technical skills and theory and principles--differ in important ways, but they also share a feature that is critical to their presumed role in practice. Both assume that expertise consists of prescriptions for what to do and that such prescriptions derive from theory or from empirical investigation of practice. The prescriptions available within each profession constitute its codified knowledge--knowledge that has been discovered or developed by others and is now in a form to be transmitted to new practitioners. Borrowing Jackson's (1986) terminology, this form of knowledge is mimetic: It is independent of its owners; it can be passed from one person to another; it adds to the knowledge base of its owners; and it can also be subtracted if they forget it.

When such a knowledge base is sufficiently detailed and sure, it can be codified into manuals. Physicians who are unsure of what to do can rely on catalogues of poisons and their antidotes, of medications, or of rashes. Engineers who are unsure can look up the stress tolerance of different materials. Gideonse (1986) has recently proposed codifying knowledge of teaching into a series of manuals that are analogous to those available to physicians and engineers. But such codification assumes that the knowledge base is in fact highly prescriptive, either because the empirical evidence is substantial or because the community

has reached substantial consensus. An American Institute of Steel Construction manual (1980) contains almost nothing but tables: allowable stress designs, allowable concentric loads, formulae for determining the static loading conditions for different beams, and so forth. Even when the Merck manual (Berkow, 1982) tells a physician how to examine a rape victim, a technical task that would presumably require technical, legal, and interpersonal issues, it describes only consensus prescription. It lists the kinds of evidence that will be needed by the legal system and suggests that the trauma of rape may make it necessary to engage in multiple interviews with the patient to obtain all the necessary information.

These manuals do not address the complicated judgments involved when practitioners adjust general principles to specific circumstances, select the most appropriate principle from several that apply, or merge multiple applicable principles into a single integrated formulation o the case. Yet such complex judgments are common in teaching, so much so that many teacher educators argue that teaching expertise is not acquired through the accumulation of mimetic knowledge--prescriptions of what to do; instead it develops when teachers have learned <u>how to decide</u> what to do. Borrowing Jackson's (1986) terminology again, we can call this a <u>transformational</u> view of professional education: Its goal is not to add to the practitioner's store of knowledge, but instead to transform the practitioner into someone who examines situations in a particular way.

<u>Expertise as Critical Analysis</u>

This third definition of expertise is still prescriptive, but

instead of prescribing procedures for handling situations, expertise as critical analysis prescribes a paradigm for examining and interpreting situations. General principles are still relevant, but instead of prescribing solutions they provide vehicles for interpreting cases.

Though many professional schools emphasize analytic technique, law schools have traditionally excluded both technical skills and basic sciences from their curricula, concentrating instead on transforming their students into people who think like lawyers. Bodenheimer (1962), for instance, has argued that the logic of deduction from premises to conclusions, or from principles to practices, is not sufficient to describe legal reasoning, for the critical issues in law have to do whether premises are true, rather than with what follows from them. Law rests on concepts whose boundaries are vague; it requires complex decisions as to whether a particular case is an example of a general case.

The most visible law school teaching technique is the "case method," first introduced into the Harvard University law school by Christopher Langdell in the late 1800s (Stevens, 1983). Appellate cases provide the material for analytic discussion, with faculty relying heavily on a question-and-answer classroom format reminiscent of Socratic teaching methods. Students learn to read material not for its main idea, but instead to read it reconstructively, as something to be taken apart and put back together again (White, 1985). In principle this method of instruction treats students not as students but as active thinkers presented with difficult situations for which there are no "answers." By immersing law students in the methods of case analysis, law schools

eventually transform their students into people who routinely apply the paradigm of legal reasoning to new situations.

A slightly weaker form of this definition of expertise exists in business schools, where basic disciplinary courses are retained, but are supplemented with a variety of techniques designed to transform students into business analysts. Business schools also provide students with more than one analytic paradigm. Some business schools concentrate on the case-analytic paradigm; others on a quantitative-analytic paradigm (Schlossman and Sedlak, 1985). In quantitatively oriented schools, students learn, and learn to apply, mathematical models from such disciplines as economics and statistics. Students immersed in the techniques of quantitative analyses can be transformed into paradigmatic thinkers just as those immersed in case analyses are. They become people who use this paradigm to approach virtually every professional decision they encounter. Despite the considerable difference between the two paradigms, they are similar in their goal of producing graduates who approach their work situations paradigmatically. That both paradigms are promoted equally vigorously suggests that there may be more than one way to think like a businessman.

Whereas other definitions of expertise were found wanting for their lack of attention to situational analysis and decision making, this definition has been criticized for its lack of attention to codified knowledge. One frequently raised criticism has been that law schools fail to provide students with technical skills for the <u>tasks</u> of lawyering--negotiating, gathering and sifting information, or preparing briefs (Thorne, 1973a). Legal educators defend their oversight by

arguing either that these skills can be readily acquired in practice and need not be attended to during professional education (Cardoza, 1977) or that attention to these skills would transform law schools into vocational schools, which in turn would demean students and curtail opportunities for intellectual and personal growth (Sandelow, 1984, cited in Pepe, 1985).

Similarly, the case method is criticized because it fails to assure that students acquire knowledge of the general principles of law (Stevens, 1983). This failure occurs in several ways. First, the exclusive emphasis on case analysis leaves no opportunities for students to grasp the overall structure of law and the general principles on which it is based. Further, even when the study of cases is intended to introduce general principles by induction from the cases, it represents an inefficient and haphazard way to convey these known principles of law. Finally, case analyses are based almost exclusively on appellate cases, so that students are only marginally exposed to public statutes and regulations, which do represent a body of general principles of law (Pepe, 1985). Thus, for those who believe that legal expertise rests on technical skills or general principles, the transformational goals of legal education are found wanting.

Another important criticism of the case method has to do with the ambiguities it introduces by emphasizing process over content. The Socratic teaching method, for instance, does not provide students with "right answers"; consequently it can leave students unsure of whether they have learned anything, or if so what they have learned (Cardoza, 1977). Cardoza reviewed the strategy and concluded, "With all this

turmoil concerning curriculum, teaching methods and growth, it is hardly surprising that lawyers and legal educators admit they have no clear idea of what the student is supposed to be learning to do" (p. 48).

Perhaps the most devastating criticism of all comes from employers of new lawyers who often complain that, while their new young lawyers can analyze cases, they are unable to make decisions--to act on the cases (Payton, 1985). One reason for this counterintuitive outcome is that appellate cases, which form the content of students' analytic work, are decisions that have already been made. By analyzing only these, students do not acquire any sense for how ideas and movements lead to decisions, for how personalities and motives shaped the case, or for the many conversations that eventually contributed to the appellate decision now found on paper. Yet, as practicing lawyers, their task will be not only to participate in these processes, but to influence them.

Finally, the case method has been criticized precisely because it is successful in transforming its students into lawyers. Law schools completely immerse their students in cases and the analysis of cases, and keep them immersed, to the exclusion of almost any other activity, for three years. Law students learn that they are entirely responsible for diagnosing the cases they read. But they also learn that this is the only material for which they are responsible (White, 1985). Yet Payton (1985) has argued that sound legal judgment requires much more than merely legal analysis. It also requires analysis of the personalities and organizations involved and an understanding of how legal decisions may affect them. She argues that law schools should include systematic study of the organizations and institutions to which law is applied--not

just the laws governing these agencies, but the agencies themselves. For Payton, sound legal judgement entails, among other things, an understanding of the interaction between law and organizational life and an ability to foresee the consequences that alternative courses of legal action may have on the people and organizations involved.

One reason why law schools--or other schools intent on transformation--may hesitate to incorporate nonparadigmatic considerations into their training is that the presence of these other considerations makes it harder to judge the appropriateness of any given decision. If it is true that the best legal decision is not necessarily the best organizational decision, as critics argue, then how is a law professor to judge the quality of a student's analysis? What are the criteria for "soundness" of decisions? Deising (1962) has distinguished five kinds of rationality that can shape social decisions: technical, economic, social, legal, and political. The first two are more dependent on means-ends analysis, but the others are not. Rational social decisions are based on mutual obligations, beliefs, and expectations; their aim is to reduce conflict and maintain the stability and internal consistency of the social system. Rational political decisions are processes by which unified solutions can be forged from multiple points of view. They cannot occur when views are so disparate that no unified solution can be developed, nor when views are so uniform that no solution is necessary. If sound legal judgement entails consideration of social, organizational, economic or political issues, as well as legal issues, then there is no clear standard for assessing the adequacy of any decision.

Law schools and professional programs also hesitate to incorporate nonparadigmatic issues into their instruction because the presence of such issues introduces important questions about the centrality of paradigmatic expertise. Wilson (1986) argues that "true" professional expertise comes with its own built-in standards for what constitutes a sound decision and that the introduction of other considerations delimits the profession's claim to expertise and casts doubt on the validity of the profession itself.

Critical analysis, then, is a form of expertise that differs from both technical skills and general principles in that it requires the professional school to transform its students into critical analysts, a feat that cannot be done simply by giving students available codified knowledge. Its disadvantages are that it can fail to provide students with codified knowledge, where such knowledge exists; it can lead students to become so analytic that they are unable to act; and it can narrow the scope of the students' analytic powers to the point where, as professionals, they are unable to view cases from any perspective other than that of their paradigm.

A Note on the Role of Arts and Sciences in Professional Education

Like law schools, the university's arts and sciences curriculum is often expected to transform students into critical analysts. Students are immersed in the concepts and rules of evidence of several disciplines and learn the distinctive paradigms of each. When this happens, the result is called a liberal education. Presumably a liberal education is not limiting in the way that a paradigmatic professional education is,

for students are exposed to a number of different paradigms. This exposure is expected to enhance analytic capacity, free students from their own preconceptions and biases, give them greater insights and understandings and consequently a greater appreciation of all aspects of life.

Teacher education and journalism are unusual among professional education programs in that each expects the university's arts and sciences curriculum to contribute to professional expertise. Schools of education assume teachers need to know the concepts and rules of evidence for the disciplines they will teach (Shulman, in press), and schools of journalism assume journalists need to know the disciplinary backgrounds of the subjects on which they will report--economics to write about current economic events, political science to write about current political events, and so forth (White, 1986).

But there is no guarantee that these courses will foster the intellectual transformation teachers and journalists presumably need. The university curriculum is such that students are rarely immersed within a single paradigm for any length of time. And there is no evidence that any particular number of credit hours will enable a journalist to frame a context within which to place a current event or to assure that teachers are facile in a discipline.

Furthermore, just as a legal education may fail to facilitate legal decisions, a liberal education may fail to facilitate other kinds of decisions (Martin, 1981). There is no evidence, for instance, that disciplinary knowledge <u>by itself</u> helps teachers make such instructional decisions as what to teach, what assignments to provide, or how to

explain concepts and rules of evidence to their own, much younger, students.

Finally, the arts and sciences curriculum is not always intended to be transformative. It is viewed by some professional educators as mimetic--that is, giving students a body of general principles they can later apply as needed. Teachers may study subject matter not to be transformed but instead to learn the material they will later teach. If arts and sciences courses play this professional role, they do not necessarily develop critical analysis in students.

Expertise as Deliberate Action

There is yet another definition of professional expertise. Like critical analysis, it assumes that a major task facing professionals is to analyze situations. But it also assumes that analysis occurs in the context of action. Further, it assumes an interactive relationship between analysis and action, such that each influences the other.

The view of expertise as deliberate action assumes expertise evolves and develops with experience, but that experience can only contribute to expertise if practitioners are capable of learning from it. The job of the professional school is to transform students into people capable of deliberation about, and critical examination of, their own actions and the consequences of those actions. This view does not deny the existence of codified general principles, nor does it deny that such principles contribute to practice. But it assumes their role is interpretive rather than prescriptive.

I take the term "deliberate" from Schwab (1978), though the

evidence for such expertise comes from Schon (1983). Following Dewey (1916), Schwab argues that the ability to successfully deliberate about courses of actions develops over time by observing one's own actions and their consequences. From these actions and reactions, the deliberate actor forms a mental catalogue of means and ends, and these in turn become organized into a tentative formulation about how things work. Schon examined the decision-making processes themselves. He found that the practitioner first had to make sense of the situation by imposing a structure or interpretive frame of reference on it. The frame of reference often came by analogy to another situation the practitioner had encountered, and it enabled the practitioner to define the new case as a member of a class with which he was familiar. Given this definition of the problem, Schon's practitioner is able to form mental experiments to see what would happen if he solved the problem as defined. An important feature of this process is that if the practitioner had used a different analogy, he or she might have defined the problem differently and consequently envisioned different sorts of solutions.

In conducting these mental experiments the practitioner envisions the consequences of his proposed solution. He then judges these consequences <u>both</u> against his definition of the problem <u>and</u> against other criteria of satisfactoriness that derive from other goals. A solution may not be satisfactory because it creates a new problem in regard to a goal that had not been previously articulated. Or it may be serendipitous in that it furthers another goal. If the consequences are not satisfactory, the practitioner reviews his original definition of the situation, surfaces the theory implicit in that definition, tries to see

what was wrong with it, and finally redefines the situation in another way in search of a better solution.

Schon (1983) studied architects, town planners, scientists, psychotherapists, and organizational managers, and found that this model of deliberate action applied to most of the practitioners he examined. Research on teacher planning (eg., Yinger, 1977; Yinger and Clark, 1982) suggests teachers may also rely on deliberate actions. They tend to conduct mental experiments, to evaluate their success with them, and to draw on experience in planning future episodes.

No professional field that I am aware of has clearly defined expertise as deliberate action, though teacher education has felt the continuing strain of a minority point of view that expertise consists of deliberate action, rather than a set of technical skills. When John Dewey (1904/1965) made his famous distinction in 1904 between laboratory and apprenticeship experiences for beginning teachers, he distinguished between experiences which engender immediate mastery of discrete skills and those that develop the intellectual methods required for eventual mastery of practice (Ball, 1987). The laboratory experiences which Dewey advocated were intensive rather than extensive, and guidance was designed to encourage thoughtful analysis of experiences rather than to convey correct procedure.

The andragogical implications of expertise as deliberate actions are considerable. Successful deliberate action requires a body of experiences on which to draw, the ability to conduct mental experiments, the ability to evaluate their outcomes critically, and the ability to revise one's definition of the situation if not satisfied with the

solutions the mental experiment yields. In addition, it requires a highly developed sense of purpose, for purpose is the criterion against which both ideas and actions are judged. Professional educators must not only provide their students with these things, but do so in a way that transforms the students into thinkers capable of deliberation and of deliberate action.

If students are to learn from their experiences, the experiences must entail both analysis and action, so that students learn the connection between the two. Students must deliberate to define problems and solutions, they must act on their deliberations, and they must evaluate their actions in light of their original formations of goals and problems. Professional programs, therefore, must design learning experiences that enable students to be full participants, not merely spectators, analysts, or advisors (Revans, 1982). The situations which students confront must be multifaceted, as are the cases presented to law students, but they must differ in an important respect: They are yet to be resolved. Thus, when students work on these problems, their work is not purely analytic but instead is motivated by the need to define the problem and to find a solution. Finally, student experiences must occur in an environment that enables the teacher to deliberate along with students as students are working and deliberating, for that is when students are most ready to learn (Schon, 1987).

Since deliberate action does entail action, teachers can explicitly help students with their skills as well as with their reasoning. Schon (1987) describes three methods his teachers used: "follow me," in which they encouraged direct imitation; "joint experiments," in which they

helped the student try alternative strategies to achieve a goal the student had set; and "hall of mirrors," in which they reflected student thinking in a way that enabled students to see, and to understand better, their own deliberations.

One of the key assumptions of this definition of expertise is that experience provides a valuable source of knowledge on which to base current and future decisions. Yet the evidence suggests that, without training, people are not very careful when inducing principles from experience. They are likely to overestimate the degree of correlation among events (Tversky and Kahneman, 1982b), to use new information to confirm rather than to test or disconfirm hypotheses (Einhorn, 1982), and to increase confidence in their judgments when they have more information, even when that information is not relevant (Oskamp, 1982).

Furthermore, the role of codified empirical knowledge, relative to experience, is unclear. When teachers blend knowledge and ideas from different sources, empirical knowledge both modifies and is modified by other kinds of knowledge (Kennedy, 1983). One result of this process is that research findings may be incorporated at the expense of being distorted from their original form. Suppose a teacher learns Research Findings "F," and Experience "e." The two are similar but not identical. To incorporate both into her body of working knowledge, she must either alter Finding F to Finding E, or reinterpret Experience e to Experience f. While there is evidence that such interpretations and alterations occur, we have no sense for why one teacher may convert F to E while another converts e to f.

Einhorn (1982) contrasts what he calls "optimal" decision rules,

which are learned deductively, with heuristic rules that are learned inductively, and finds the latter wanting in three ways. First, heuristics are generalized across content areas rather than problem structures. That is, instead of recognizing a problem as an example of a particular logical structure, people recognize it as a example of a certain subject matter. This tendency is so great that different written descriptions of a problem can lead people to define the same problem differently. Einhorn suggests that, because problem structures are difficult for most people to see, they focus instead on content. Second, to be useful, heuristics must be sufficiently general to apply to classes of situations. Yet these classes must be defined by the learner, and if the tendency is to perceive problems as content-dependent, and not to recognize their underlying structure, the classes of events to which heuristics are applied will also be based on content rather than structure. Finally, the process of learning by induction is such that learners may be reinforced for incorrect rules. Tendencies to use information for confirmation rather than disconfirmation, for instance, do not allow people to discover the errors of their heuristics but instead falsely increase their confidence in them.

But studies of problem-solving heuristics occur in laboratory settings, where experimenters presume independent and perfect knowledge of what the goal is, what the problem is, and how its solution can best be achieved. They may misrepresent both the nature of the tasks normally confronted by professional practitioners and the validity of the task-analytic strategies employed in real professional situations. The important intellectual task of deliberate action is not problem solving--

the weighing of alternatives to reach a predetermined end--but instead is problem setting, where goals, means and ends are all weighed together.

In fact, most research on human judgment assumes a rational form of decision making where the goal is both fixed and known. In contrast, the deliberate-action model of decision making assumes goals may change over time and that they may not be entirely known at the outset. That practitioners prefer deliberate action to rational action is demonstrated by May (1986), who contrasts the rational lesson-planning model routinely taught to prospective teachers with the planning strategies actually used by practicing teachers. The rational model for lesson planning begins with a statement of objectives, moves to a selecting strategies for achieving those objectives, implementating those strategies, and then evaluating them relative to the original objectives. It assumes, in other words, that goals are known in advance and remain fixed throughout the lesson.

In the past, researchers have tended to assume that teacher noncompliance with this model indicated lack of skill; May suggests that teacher noncompliance may indicate inadequacy of the model itself. Research on teacher planning suggests teachers use a recursive planning process analogous to that implied by the deliberate action model: They visualize, modify and elaborate plans as they go, drawing heavily on student responses and often not identifying learning objectives until they are actually engaged in instruction (Clark and Peterson, 1986). But, as Clark and Peterson (1986) point out, studies of how practitioners actually deliberate about their work do not indicate whether practitioner

deliberations are in fact functionally superior to rationally derived models of decision making.

That human beings may use potentially biasing heuristics makes more important their ability to evaluate critically both real and mental experiments, for the deliberate-action model assumes that such analysis not only leads to the most appropriate solution to the problem at hand, but that it also enables the practitioner to learn from the experience. The notion of critical analysis of one's own actions and their consequences is particularly important in teacher education, for there is evidence that new teachers enter the profession with a priori assumptions about what teaching is and what constitutes good teaching (Nemser, 1983; Tabachnick and Zeichner, 1984). Unless these ideas are explicitly addressed by teacher educators, novice teachers can enter teaching without substantially altering their preconceptions (Feiman-Nemser and Buchman, 1986a, 1986b). Further, the nature of these preconceptions may be such that they prevent teachers from deliberation and consequently learning how to learn from their experiences.

The notion of professional purpose is also problematic. Schon (1983) found that practitioners judged the results of their mental experiments according to several criteria: how well the experiment solved the problem as defined, whether the practitioner liked what happened when that solution was implemented, whether the action made the situation coherent, and whether the solution was congruent with fundamental values and theories of practice. All of these criteria are ambiguous. They continually evolve in light of new experiences. The architect who likes what he sees when he tries to construct a building in

a particular way could not have defined in advance what would have constituted a satisfactory solution; the teacher who decides to digress into fractions today could not have explained earlier her criteria for digressions. The criteria are discovered in the process of enactment.

That goals are developed in response to the situation also raises questions about the ultimate validity of any professional decision. When Anyon (1981) studied teachers serving students from different social classes, she found that the goals of instruction were quite different across the social classes. In schools serving low socioeconomic groups, teachers defined knowledge as a collection of facts to be learned by drill and practice. They made little attempt to explain to their students why they engaged in any particular activity. In schools serving upper socioeconomic groups, teachers viewed knowledge as consisting of different ways of thinking that could be learned by questioning and by being questioned. These professionals were making important judgments about educational goals and the means of attaining them. They taught children from different social classes different kinds of knowledge and could have substantially influenced the future capacities of their students.

Though expertise-as-deliberate-action acknowledges a role for both normative and theoretical principles, it also assumes ideas and goals are altered by the situations. That goals and principles are situation-dependent makes it difficult for an independent observer to assess the appropriateness of a professional decision. As Sganerelle discovered, "In our job we can make a mess of a man without it costing us anything. If we blunder it isn't our look out: It's always the fault of the fellow

who's dead and the best part of it is that there's a sort of decency among the dead, a remarkable discretion."

The Fallibility of Expertise

None of the definitions of expertise described above can assure satisfactory solutions to professional problems. Technical skills segment practice and fail to provide the judgment and reasoning that determine whether or when to apply particular skills. Theory and principles prescribe broader rules of thumb, but they tend to be unidimensional and cannot provide rules of thumb regarding how to apply unidimensional principles to multidimensional situations. Critical analysis gives practitioners paradigms for analyzing situations, but fails to provide the action implications of analysis. Deliberate action permits goals as well as means to vary across situations, thus minimizing role of standards of accountability.

Each definition of expertise entails assumptions about the nature of professional practice that must be fitted, comfortably or uncomfortably, onto the situations practitioners encounter. When expertise is defined as technical skills or general principles, the array of professional situations is assumed to be known in advance. If problems do not fit available techniques or principles, professionals must redefine them into ones for which they have solutions. When expertise is defined as critical analysis, professionals define situations using the paradigm they have learned. None of these ways of defining or solving problems necessarily matches the client's definition, and the lack of fit makes clients aware of the fallibility of

professional expertise. Here is what happened to Moliere's character Veronte, when he questioned his doctor's explanation. Veronte says, "It was very clearly explained, but there was just one thing that surprised me--that was the positions of the liver and the heart. It seemed to me that you got them wrong way about, that the heart should be on the left side and the liver on the right." The doctor, Sganerelle, replies, "Yes, it used to be so but we have changed all that. Everything's quite different in medicine nowadays."

Transition to Practice

Closely associated with questions of what expertise is and how it is acquired are questions about how students make an optimal transition from the university to practice. Most programs require that students participate in some form of supervised practice, or transitional experience, prior to entering independent practice. Yet both the nature and the purpose of these transition experiences are diverse.

The quickest way to move from study into practice is by immersion--the sink-or-swim method of introduction into a profession. When entrepreneurs establish new businesses, they learn the business by immersion. That the vast majority of new business fail each year may attest to the inadequacies of immersion as a method for mastering a profession. Immersion essentially means that students move directly from university classrooms to their first jobs. The responsibility for assuring that they learn how to apply necessary skills or principles is left either to the student or to the first employer. Business students and many law students enter their professions by immersion.

Immersion has been shown to be an effective method of transforming students into paradigmatic thinkers--people who think like lawyers--but its value as a method for learning practice is more questionable. Practice is fast paced, requires a number of varied decisions and procedures with which the novice is only minimally acquainted, and requires the novice to assume full responsibility for them all. Immersion with no benefit of guidance can foster the development of bad habits as well as good, as the new practitioner engages in a desperate attempt to keep afloat (Hopkins, 1985; Feiman-Nemser and Buchman, 1983; White, 1985; Seager, 1985; Guttman, 1985; Peterson and Finn, 1985).

The alternatives to immersion have different labels in different bodies of professional literature. The language I use in the next several paragraphs is not intended to settle language disputes, but rather to facilitate a discussion of the nature of the options.

One alternative to immersion is <u>apprenticeship</u>, by which I mean the sort of on-the-job training provided by employers in earlier centuries, unconnected to formal courses of study offered by the university. Because the quality and value of the apprenticeship experience is controlled entirely by the particular master, the system as a whole can produce highly variable results. For some, apprenticeship experience is controlled entirely by the particular master, the system as a whole can produce highly variable results. For some, apprenticeship means "Sit by Nellie" and copy what she does (Arnstine, 1975); for others it means working under a master craftsman who reconstructs the craft for the apprentice, describing and demonstrating the professions' guiding

principles, and gradually increasing the apprentice's responsibilities (Collins and Brown, in press).

Contemporary professional educators are generally opposed to apprenticeship on the grounds that the knowledge acquired this way is haphazard, incomplete, and situation-specific; that it may consist largely of procedures with no attention to the underlying principles that should guide practice; and that there is no quality assurance since each apprentice is judged by his or her own master. Problems with immersion and apprenticeships have motivated most professional education programs to devise transition experiences for students, where students are not overwhelmed or unable to make sense of their practice, and where faculty can assure that students make the right kind of sense out of their practice. I list these forms of transition in order of proximity to the university relative to practice.

First, universities can offer <u>laboratory experiences</u>, in which students have an opportunity to practice techniques or to observe concepts or principles that have been described in their university courses. These experiences rarely simulate practice very closely, nor are they intended to. Their purpose is to demonstrate the specific application of specific techniques, concepts or principles in a setting where students will not be confused by other irrelevant data. Laboratory experiences can range from dissecting animals to drafting lesson plans to calculating statistics. What makes laboratory experiences different from other forms of transition is their attention to the application of predefined techniques or principles--codified knowledge. They are most

commonly criticized for their failure to attend to the complexities of real situations.

Second, universities can offer simulations, experiences which simulate the dilemmas of practice, rather than principles or concepts which may be applied to practice. Whereas laboratories involve students in tasks with fixed predefined outcomes, simulations engage students in tasks whose outcomes are not so clearly known in advance. Virtually every professional field has demonstrated some interest in creating such ill-defined problems or projects for its students (Bennett, 1984; Neufeld and Chong, 1985; Burgoyne, 1985; Williamson and Hudsperth, 1982; and Nadler and Seireg, 1982). A problem is a multidimensional situation which contains an unresolved question: should company "X" purchase company "Y," for instance. Students may attack the problem by analyzing cash flow, net balance sheets, impact on stock prices, impact on bond ratings, or impact on the organization and its human resources. A project is analogous to conventional term papers in that students determine their own goals and strategies. They may be required to design a building or bridge of their own choosing, for instance. Like problems, projects are multifaceted and can simulate the full complexity of practice. They have the additional advantage of making students choose their own goals.

Even though simulations introduce students to the ambiguities of practice, they still do so in a protected environment, for students must worry about only one case, client, or problem at a time, rather than a full portfolio of cases. Further, they can compare their plans and solutions with those of their peers, learning from their peers' ideas as

well as from their own, and they can receive guidance and feedback from faculty. Simulations are also protected from the constraints of real practice, in that the teacher can stop action midstream to discuss technique or rationale with the student, and the student can be back and try again.

Third, universities can provide clinical experiences, which differ from simulations in that students must address real situations, rather than faculty-generated problems or projects, and they may need to address multiple concurrent problems, just as practicing professionals do. But the setting in which they face these difficulties is still university-dominated, and therefore sheltered. If it is a full-service hospital, for instance, it nevertheless is a hospital that considers teaching to be a major part of its responsibility, thus differentiating it from other hospitals.

Finally, universities can often arrange for students to participate in internships. Internships are analogous to apprenticeships in many ways; students work at real jobs in real practices rather than in university-sponsored practices. They have local mentors who serve roles analogous to that of the apprentice masters. But along with this on-the-job experience, interns participate in courses or seminars designed to ensure that broader meanings are attached to particular experiences.

Internships are the contemporary replacement for apprenticeships in many professional programs. They are popular in part because they are cheaper than clinical experiences (Zumeta and Solomon, 1982). In addition, because clinical experiences do not fit the conventions of the universities, in which professional schools are housed, it is difficult

for professional schools to justify the expense and effort entailed in clinical experiences. Internships offer the advantage that supervision is provided by a host institution--an employer--rather than by the faculty of the professional school. But this fact introduces three problems for the professional program: how to control the nature of supervision students receive, how to provide students with opportunities to analyze their experiences and connect them to the principles they learned in their university classes, and how to assure that the internship is really a transition experience and not an immersion experience.

With regard to supervision, there is no reason to believe that practicing professionals will be motivated to provide the kind of supervision that the professional program would want, nor that they would know. Host professionals are practitioners, whose obligation is to their practice, not to their interns. Cooperating teachers, for instance, rarely provide student teachers with specific feedback on the quality of their teaching (McIntyre and Killian, 1986; Zimpher, deVoss, and Nott, 1980) and many concentrate on the "how-to" aspects of the job at the expense of attending to issues of "why," Under these circumstances, programs have difficulty assuring that their students receive any supervision or guidance at all, much less guidance corresponding to that which programs would desire.

Concerns over the student's opportunity to analyze experiences are important if expertise rests on general principles or on deliberate action, for both of these definitions require students to operate on the basis of thoughtful application of principles rather than merely copying

the behavior of others. Garrison (1983) has distinguished a variety of ways in which journalism educators have mixed seminars with internships in order to assure that students get maximum benefit from the internship. His distinctions are based on the number of credit hours students receive for the internship and for the seminar and on whether either is required or optional. He does not discuss the quality or content of interactions between interns and university personnel. Tabachnick, Popkowitz, and Zeichner (1979-80) found that university supervisors providing guidance to student teachers tended to focus on technical skills rather than general principles or deliberation.

Finally, with regard to the nature of the internship experience, teacher educators from Dewey (1904/1965) to the present (Eggleston, 1985) have recognized that the methods student teachers use to copy with the initial demands of their student teaching experiences can hinder their later professional development. Similarly, in social work, Guran and Williams (1973) have found that internship caseloads are often so large that students could not possibly learn to handle them well, nor could they possibly receive adequate guidance in their handling of any particular case. Hodges (1982) has argued that the changes in values observed among teaching interns--toward technical skills and away from theory, toward control and away from experimentation--are not due to the influences of cooperating teachers, but are instead the same changes that occur under immersion. These findings suggest that the internship experience as it appears in teacher education is virtually an immersion experience.

Another problem with providing either internships or clinical experiences has to do with the length of time students need to spend in such sheltered experiences prior to being released to independent practice. The requirements vary considerably across professions. Journalism accreditation rules limit internship experiences to about 3 percent of the student's total undergraduate program (Garrison, 1983); teacher education typically provides students with 8 or 9 percent (Kluender, 1984) and legal internships are still electives, usually for only three course credits (Pepe, 1985). In these professions, transition experiences are a relatively small part of professional education. Yet medicine requires two years of clinical experience (Thorne, 1973b).

There is evidence that the traditional 8 to 15 week student-teaching internships do not succeed in helping students apply the principles they were taught in their courses (Zeichner, 1980), nor in transforming students into deliberate actors (Eggleston, 1985). Fullan (1985) has argued that implementation of new ideas requires at least two years, and thus it is no surprise that teacher-education internships have minimal or even negative impact. With insufficient guidance, and with insufficient time to master the immediate demands, students never get to a point where they can analyze their practice and take control of it.

Not surprisingly, views about the purpose and role of transition experiences are related to views of what expertise is. If expertise is construed to be discrete technical skills, then the model described by Joyce and Showers (1980) would be appropriate. These researchers suggest that students first receive information about the particular skills, then

practice it in laboratory settings and then be coached in the context of practice.

When expertise is considered the application of theory or general principles, transition experiences need to play two roles: They can show students how to apply individual principles to particular situations--that is, how to recognize cases as examples of principles (Seager, 1985)--and they can help students integrate knowledge (Stark and Lowther 1986). The first role suggests that transition experiences be provided in a laboratory, so that students can master each principle and its application without being confused by others. Thus, when medical students participate in an anatomy lab concurrent with their anatomy course, they have the opportunity to see, each week, what the lectures and texts have been describing. The second role suggests that transition experiences should occur in a variety of situations, many of which illustrate more than one principle concurrently, so that students must draw on the entire body of theory and principles they have learned. Thus, when medical students participate in third-year clinical clerkships, they have the opportunity to integrate knowledge from all the disciplines and to see how it all relates to practice.

Both roles suggest a necessary learning sequence through which students progress. First they learn the theory and principles of each discipline, they learn to apply the rules in a supervised setting, and finally they learn to apply the rules in independent practice. The presumed purpose of the intermediate step, the transition experience, is to teach students how to apply the previously learned codified knowledge base to ambiguous situations. Thus, when the American Association of

Engineering Educators recommended more laboratory experience for their students, the rationale was that it would "serve to reinforce the concepts presented in other parts of the educational program" (Ernst, 1985-86, p. 163).

When expertise is defined as critical analysis, as it is in law and business, no transition is apparently necessary, for once the student is transformed into a paradigmatic thinker, he or she will automatically approach practical situations using the paradigm. No coaching or guidance is necessary. One reason advocates of clinical legal education are unable to persuade their colleagues of the importance of transition experiences is that their arguments are based on different definitions of expertise. For example, Leleiko (1979) argues that clinical experiences give students an empirical basis for understanding the principles of law, something that a legal educator steeped in paradigmatic analysis would not appreciate.

When expertise is viewed as deliberate action, transitional experiences must provide students with opportunities to conduct experiments, test ideas, and formulate goals. An architecture design studio focusing on housing for the elderly may encourage students to study sociology of the elderly, to go on field trips, take photographs, keep journals and so forth, as they plan their housing designs (Ellis, 1981). Hopkins (1985) argues that transition experiences should encourage students to try ideas systematically and to take more responsibility for their own professional development; Eggleston (1985) that theory be introduced after, rather than before, transitional experiences, as part of the faculty's effort to foster reflection and

analysis regarding those experiences. These authors suggest that transitional experiences should be encountered early and continuously throughout the teacher education program, so that students have ample opportunity to reflect on their experience and to discuss them with their professors.

In some professions, the role of transition experiences is not self-evident. Guttman (1985) describes a historical debate within architecture about the purpose and role of studio design in the architect's preparation. One side argues that studio design should help students apply the specific principles they have learned; the other that studio design should acquaint students with the full complex of issues that enter into decisions about buildings. The first side, which Guttman calls the "purists," advocates that studio design should deal with pure design issues, even if they must be presented to students in an unrealistic way. The second side, which Guttman calls the "simulators," argues that studio design is where budding architects should come to terms with client desires, building codes, costs of materials, feasibility of structures, and so forth. Porter (1979) lists several views about what architectural "design" is--pure geometric representation, an integration of all aspects of buildings, an integration of knowledge, or self-expression. He argues that design is in fact all of these things and that architecture educators need to think of them separately, for each may imply a unique kind of transition experience.

Several points are worth mentioning about these different roles for transition experiences. One is that, for most definitions of expertise,

some form of transition experience is implied. If the profession defines expertise as technical skill, its practitioners need opportunities to practice their skills. If it defines expertise as theory and principle, its practitioners need to practice connecting principles to specific situations. If the profession defines expertise as deliberate action, its practitioners need to learn how to assess situations and how to learn from them. Only when expertise is defined exclusively as paradigmatic thinking can practitioners be expected to move into practice by immersion.

Second, each role for transition experiences still leaves some aspect of practice to be learned elsewhere, presumably in practice. If the transition experience attend to relationships between general principles and particular cases, it may leave technical skills to be acquired in practice; if it helps students learn to deliberate on their practice, it may fail to assure that they possess the available codified knowledge. And so forth.

Third, these definitions also imply different relationships between transition experiences and professional course work. If expertise consists mainly of an integrated body of general principles, then the transition experience follows all formal course work. If it consists of discrete skills, or even discrete theories and principles, then transition experiences should accompany each course, illustrating ideas as students encounter them (Webb, 1981; Smith, 1980). If it consists of learning from experience, then transition experiences need to occur concurrent, or even <u>prior</u> to, formal courses (Hopkins, 1985). In fact,

Denton (1982) found that field experiences of prospective teachers had a greater impact on future courses than on concurrent courses.

The Problem of Developing Expertise

Though there are variations both within and across professions, each profession demonstrates general tendencies that differentiate it from the others. Teacher educators emphasize the technical skills of the profession; medical educators, theory and general principles; and legal educators, critical analysis. Engineering and public planning schools have moved in the last two decades from an emphasis on technical skills toward an emphasis on general principles, while business provides students an amalgam of principles and paradigmatic analytic strategies.

Why such patterns exist is difficult to said. One hypothesis is that the professions themselves really do require different kinds of expertise--that is, medicine and engineering require the application of codified knowledge, whereas law and business require paradigmatic reasoning. This analysis does not apply well to teaching, however, for its history tends toward an emphasis on technical skills whereas its practice appears to require complex judgments. Another hypothesis is that programs provide the kinds of expertise they know how to provide, whether or not it is necessarily appropriate for the work. This hypothesis may account for teacher education's emphasis on technical skills. The field has only recently developed a body of general principles that could be applied to teaching practice, and it has been sufficiently underfunded (Pesseau and Orr, 1980) that it could probably not clinically prepare teachers to be deliberate actors.

Yet another hypothesis is that a profession's definition of expertise depends on the quality of students who enroll in the program. Early debates about the use of the case method in law, for instance, rested in part on whether students of ordinary ability could profit from such instruction. Once admission criteria were raised, this no longer was an issue (Stevens, 1983). Since teacher education has a tendency to attract lower ability students (Kerr, 1983), perhaps its tendency toward technical skills is a response to its perception of the capacity of its student body.

Finally, it is possible that these definitions reflect institutional responses to critics. Even as professional educators are encouraged by the university to teach theory or general principles, they are chastised by critics who question the value of theory and press for more practical content. In Moliere's The Imaginary Invalid, Beraldo represents the latter view when he complains about his brother's doctor: "All that their art consists of is a farrago of high-sounding gibberish, specious babbling which offers words in place of sound reasons and promises instead of results." These pressures from critics may make it difficult to scrutinize professional practice objectively and determine the forms of expertise that guide it.

Regardless of the incentives, definitions must be made. To develop a professional education program, educators must define expertise, define the relationship between codified knowledge and experiences in the formation of expertise, and determine the appropriate type and scope of transitional experiences. These decisions force them to define something that is not well understood, to ignore some aspects of it in order to

make sense of others and ultimately to provide an education that cannot prepare professionals for all the demands of practice.

Despite the endurance of these questions about expertise and how it is acquired, and despite the practical need for a deeper understanding of it, there has been very little empirical research on the nature of professional expertise or on the implications of its nature for its acquisition. One result of this lack of research is that the relationship between professional education programs and professional expertise continues to be far from understood and continues to be the subject of much debate. Without more serious inquiry into these matters, even those corners of the puzzles that could be resolved will remain elusive.

References

Alonzo, W. (1986). The unplanned paths of planning schools. The Public Interest 82(Winter), 58-71.

American Institute of Steel Construction (1980). Manual of steel construction. Chicago: Author.

Anyon, J. (1981). Social class and school knowledge. Curriculum Inquiry, 11, 3-42.

Arnstine, D. (1975). Apprenticeship as the miseducation of teachers. In R. Pratt (Ed.) Philosophy of education 1975; (Proceedings of the 31st annual meeting of the Philosophy of Education Society). San Jose, CA: Society for Studies in Philosophy and Education.

Ball, D. L. (1987, April) Laboratory and apprenticeship: How do they function as metaphors for practical experience in teacher education? Paper presented at the annual meeting of the American Educational Research Association, Washington, DC.

Bennett, J. (1984). Diverse sequence of courses focuses on problem-solving. Journalism Educator, 39(1), 23-26.

Berkow, R. (Ed.) (1982). The Merck manual of diagnosis and therapy. (14th ed.). Rahway, NJ: Merck Sharp and Dohme Laboratories.

Bodenheimer, E. (1962). Jurisprudence: The philosophy and method of the law. Cambridge, MA: Harvard University Press.

Borrowman, M. L. (1956) The liberal and technical in teacher education. New York: Teachers College, Columbia University.

Brophy, J. (1986a). Teaching and learning mathematics: Where research should be going. Journal for Research in Mathematics Education, 17, 323-346.

Brophy, J. (1986b). Where are the data?--A reply to Confrey. Journal for Research in Mathematics Education, 17 361-368.

Brophy, J., and Good, T.L. (1986). Teacher behavior and student achievement. In M. C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp.358-375). New York: Macmillan.

Broudy, H.S. (1984). The university and the preparation of teachers. In L. Katz and J. D. Raths (Eds.), Advances in teacher education (Vol.1, pp. 1-8). Norwood, NJ; ABLEX.

Burdin, J. L. and Lanzilotti, K. (Eds.). (1969). A reader's guide to the comprehensive models for preparing elementary teachers. Washington, DC: ERIC Clearinghouse on Teacher Education.

Burgoyne, S. J. (1985). Curricula and teaching methods in management education. In Sinclair Goodlad (Ed.) Education for the professions: Quis custodiet . . . ? (pp. 141-147). Guildford, England: NFER-Nelson

Bussis, A. Chittenden, E., and Amarel, M. (1976). Beyond surface curriculum. Boulder, CO: Westview.

Cardoza, M. H. (1977) Untitled paper. In B. A. Boley, Crossfire in professional education: Students, the professions and society (pp. 39-55). New York: Permagon.

Charters, W. W., and Waples, D. (1929) Commonwealth teacher training study. Chicago: University of Chicago Press.

Clark, C. M., and Peterson P. L. (1986) Teachers' thought processes. In M. C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp. 255-296). New York: Macmillan.

Collins, A., and Brown, J.S. (in press). The new apprenticeship: Teaching students the craft of reading, writing and mathemathics. In L. B. Resnick (Ed.) Cognition and instruction: Issues and agendas. Hillsdale, NJ: Lawrence Erlbaum Associates.

Confrey, J. (1986). A critique of teacher effectiveness research in mathematics education. Journal for Research in Mathematics Education, 17, 347-360.

Deising, P. (1962) Reason in society: Five types of decisions and their social conditions. Westport, CT: Greenwood.

Denton, J. J. (1982). Early field experience influence on performance in subsequent coursework. Journal of Teacher Education, 33(2), 19-23.

Dewey, J. (1916). Essays in experimental logic. New York: Dover.

Dewey, J. (1965). The relation of theory to practice in education. In M. L. Borrowman (Ed.) Teacher education in America: A documentary history. New York: Teachers College Press. (Original work published 1904)

Dinham, S. M., and Stritter, F.T. (1986). Research on professional education. In M. C. Wittrock (Ed.) Handbook of research on teaching (3rd ed., pp. 952-969). New York: Macmillan.

Dodl, N. R. (1969). A guide to a model for the preparation of elementary school teachers. In J. L. Burdin and K. Lanzilotti (Eds.), A reader's guide to the comprehensive models for preparing elementary teachers (pp. 3-21). Washington, DC: ERIC Clearinghouse on Teacher Education.

Dougherty, R. E. (1950). The development of professional education. Pittsburgh: Carnegie Institute of Technology.

Eggleston, J. (1985). Subject centered and school based teacher training in the postgraduate certification of education. In D. Hopkins and K. Reid (Eds.), Rethinking teacher education (pp. 173-194). Kent, England: Croom Helm.

Einhorn, H. J. (1982) Learning from experience and suboptimal rules in decision making. In D. Kahneman, P. Slovic, and A. Tversky (Eds.), Judgment under uncertainty: Heuristics and biases (pp. 268-283). New York: Cambridge University Press.

Ellis, W. R. (1981). The social in the studio. Journal or Architectural Education, 34, 29-31.

Elstein, A. S., Shulman, L. S., and Sprafka, S.H. (1978). Medical problem solving: An analyysis of clinical reasoning. Cambridge, MA: Harvard University Press.

Ernst, E. W. (1985-86). The undergraduate engineering laboratory. Engineering Education, 76, 163-165.

Evertson, C., Hawley, W., and Zlotnik, M. (1984). The characteristics of effective teacher preparation programs: A review of the research. Nashville, TN: Peabody College.

Feiman-Nemser, S., and Buchman, M. (1983). Pitfalls of experience in teacher education (Occasional Paper No. 65). East Lansing: Michigan State University Institute for Research on Teaching.

Feiman-Nemser, S., and Buchman, M. (1986a) When is student teaching teacher education? (Research Series No. 178). East Lansing, MI: Michigan University Institute for Researach on Teaching.

Feiman-Nemser, S., and Buchman, M. (1986b). Knowing, thinking and doing in learning to teach: A research framework and some initial results (Research Series No. 180). East Lansing: Michigan State University Institute for Research on Teaching.

Fullan, M. (1985). Integrating theory and practice. In D. Hopkins and K. Reid (Eds.), Rethinking teacher education (pp. 195-211). Kent, England: Croom Helm.

Gage, N. L. (1977). The scientific basis of the art of teaching. New York: Teachers College Press.

Gage, N. L. (1985). Hard gains in the soft sciences: The case of pedagogy. Bloomington, IN: Phi Delta Kappan.

Garrison, B. (1983). Internships vary widely in structure and academic status. Journalism Educator, 38(1), 3-7.

Gessner, P. K., Katz, L. A., and Schimpfhauser, F. T. (1981). Sociomedical issues in the curriculum: A model for institutional change. Journal of Medical Education, 56, 987-993.

Gideonse, H. D. (1986). Blackwell's commentaries, engineering's handbooks and Merck's manuals: What would a teacher's equivalent be? Educational Evaluation and Policy Analysis, 8, 316-323.

Gordon, R. A., and Howell, J. E. (1959). Higher Education for Business. New York: Columbia University Press.

Guran, A., and Williams, D. (1973). Social work education. In E. C. Hughes (Ed.), Education for the professions of medicine, law, theology and social welfare (pp. 201-247). New York: Carnegie Foundation for the Advancement of Teaching.

Guttman, R. (1985). Educating architects: pedagogy and the pendulum. The Public Interest, 80(Summer), 67-91.

Haberman, M., and Stinnett, T. M. (1973). Teacher education and the new profession of teaching. Berkeley, CA: McCutchan.

Hall, G. E., and Jones, H. L. (1976). Competency-based education: A process for the improvement of education. Englewood Cliffs, NJ: Prentice-Hall.

Harrisberger, L. (1985). Curricula and teaching methods in engineering education. In S. Goodlad (Ed.), Education for the professions: Quis custodiet . . .? Guildford, England: NFER-Nelson.

Hodges, C. (1982). Implementing methods: If you can't blame the cooperating teacher who can you blame? Journal of Teacher Education, 33(6), 25-29.

Hopkins, D. (1985). Making perfect? Form and structure in teaching practice. In D. Hopkins and K. Reid (Eds), Rethinking teacher education (pp. 131-152). Kent, England: Croom Helm.

Jackson, P. W. (1986). The practice of teaching. New York: Teachers College Press

Jencks, C., and Reisman, D. (1969). The academic revolution. New York: Anchor Books.

Joyce, B. R. (1969). A guide to the teacher-innovator: A program to prepare teachers. In J. L. Burdin and K. Lanzilotti (Eds.), A reader's guide to the comprehensive models for preparing elementary teachers (pp. 105-157). Washington, DC: ERIC Clearinghouse on Teacher Education.

Joyce, B. R., and Showers, B. (1980). Improving inservice training: the message of research. Educational Leadership, 37, 379-385.

Jungermann, H. (1986). The two camps on rationality. In H. R. Arkes and K. R. Hammond (Eds.), Judgment and decision making: An interdisciplinary reader. New York: Cambridge University Press.

Kahneman, D., Slovic, P., and Tversky, A. (Eds.). (1982). Judgment under uncertainty: Heuristics and biases. New York: Cambridge University Press.

Kahneman, D., and Tversky, A. (1982). Intuitive prediction: Biases and corrective procedures. In D. Kahneman, P. Slovic and A. Tversky (Eds.), Judgment under uncertainty: Heuristics and biases. (pp. 414-421). New York: Cambridge University Press.

Kennedy, M. M. (1983). Working knowledge. Knowledge: Creation, Diffusion, Utilization, 5, 193-211.

Kerr, D. H. (1983). Teaching competence and teacher education in the United States. In L. S. Shulman and G. Sykes (Eds.), Handbook of teaching and policy (pp. 126-149). New York: Longman.

Kluender, M. M. (1984). Teacher education prgrams in the 1980s: Some selected characteristics. Journal of Teacher Education, 35(4), 33-35.

Koerner, J. D. (1963). The miseducation of American teachers. Boston: Houghton Mifflin.

Leleiko, S.H. (1979). Clinical education, empirical study, and legal scholarship. Journal of Legal Education, 30(1-2), 149-165.

Martin, J. R. (1981). Needed: A new paradigm for liberal education. In J. F. Soltis (Ed.), Philosophy and education (80th yearbook of the National Society for the Study of Education, Part I, pp. 37-59). Chicago: University of Chicago Press.

May, W. (1986). Teaching students how to plan: The dominant model and alternatives. Journal of Teacher Education, 37(6), 8-12.

McGlothlin, W.J. (1960). Patterns of professional education. New York: Putnam.

McIntyre, D. J., and Killian, J.E. (1986). Students' interactions with pupils and cooperating teachers in early field experiences. The Teacher Educator, 22(2), 2-9.

Meehl, P. E. (1954). Clinical versus statistical prediction. Minneapolis, MN: University of Minnesota Press.

Meehl, P. E. (1977). When shall we use our heads instead of the formula? In P. Meehl (Ed.), Psychodiagnostics: Selected papers. New York: Norton.

Moliere. (1959). A Doctor in Spite of Himself. In The Misanthrope and other plays (John Wood, Trans.) Hammondsworth, England: Penguin Books. (Original work published 1666)

Moliere. (1959). The Imaginary Invalid. In The Misanthrope and other plays (John Wood, Trans). Hammondsworth, Middlesex (England): Penguin Books. (Original work published 1673)

Morehead, J. H. (1973). Professional education: The theory practice issue reconsidered. College Student Jouronal, 7(4), 71-82.

Nadler, G., and Seirig, A. (1982). Professional Engineering Education in the classroom. Engineering Education, 72, 781-787.

Nemser, S.F. (1983). Learning to teach. In L. S. Shulman and G. Sykes (Eds.), Handbook of teaching and policy (pp. 150-170). New York: Longman.

Neufeld, V., and Chong, J. P. (1985). Problem-based professional education in medicine. In Sinclair Goodlad (Ed.) Education for the professions: Quis custodiet . . . ? (pp. 249-256). Guildford, England: NFER-Nelson.

Oskamp, S. (1982). Overconfidence in case-study judgments. In D. Kahneman, P. Slovic and A. Tversky (Eds.), Judgment under uncertainty: Heuristics and biases (pp. 287-293). New York: Cambridge University Press.

Payton, S. (1985). Is thinking like a lawyer enough? University of Michigan Journal of Law Reform, 18, 233-250.

Peck, R. F., and Tucker, J. A. (1973). Research on teacher education. In R. M. W. Travers (Ed.), Second handbook of research on teaching (pp. 940-974). Chicago: Rand McNally.

Pellagrino, E. D. (1977). Untitled paper. In B. A. Boley (Ed.), Crossfire in professional education: Students, the professions and society (pp. 1-17). New York: Permagon Press.

Pepe, S. D. (1985). Clinical legal education: Is taking rites seriously a fantasy, folly or failure? University of Michigan Journal of Law Reform, 18, 307-340.

Pesseau, B., and Orr, Pl. (1980). The outrageous underfunding of teacher education. Phi Delta Kappan, 62, 100-102.

Peterson, K. D., and Finn, C. E. Jr. (1985) Principals, superintendents, and the administrator's art. The Public Interest, 79(Spring), 42-62.

Pierson, F. C. (Ed.). (1959). The education of American businessmen: A study of university-college programs in business administration. New York: McGraw-Hill.

Porter, W. (1979). Architectural education in the university context: Dilemmas and directions. Journal of Architectural Education, 32(3), 3-7.

Revans, R. W. (1982). The origins and growth of action learning. Bromley, England: Chatwell-Bratt.

Roberts, D. A. (1985). Theory, practice and the student of education. The Journal of Educational Thought, 19(1), 85-94.

Romberg, T. A., and Carpenter, T. P. (1986). Research on teaching and learning mathematics: Two disciplines of scientific inquiry. In M. C. Wittrock (Ed.), Handbook of research on teaching (3rd ed., pp 850-905). New York: Macmillan.

Schlossman, S., and Sedlak, M. (1985). The age of autonomy in American management education. Selections: The Magazine of the Graduate Management Admissions Council, 1(3), 16-26.

Schofield, J. R. (1984). New and expanded medical schools, mid-century to the 1980s. San Francisco: Jossey-Bass.

Schon, D. A. (1983). The reflective practitioner. New York: Basic Books.

Schon, D. A. (1987). Educating the reflective practitioner. San Francisco: Jossey-Bass.

Schwab, J. J. (1978). Science, curriculum, and liberal education: Selected essays. (I. Westbury and N. J. Wilkof, Eds.). Chicago: University of Chicago Press.

Seager, P. (1985). Curricula and teaching methods in medical education. In S. Goodlad (Ed.), Education for the professions: Quis custodiet . . . ? (pp. 125-132). Guildford, England: NFER-Nelson.

Shalock, H. D. (1969). A guide to a comptency-based, field-centered systems approach to elementary teacher education. In J. L. Burdin and K. Lanzilotti (Eds.), A reader's guide to the comprehensive models for preparing elementary teachers (pp. 51-83). Washington, DC: ERIC Clearinghouse on Teacher Education.

Sheahan, J. (1980). Some aspects of the teaching and learning of nursing. Journal of Advanced Nursing, 5, 491-511.

Short, E. C. (1985). The concept of competence: Its use and misuse in education. Journal of Teacher Education, 36(2), 2-6.

Shulman, L. S. (1986). Those who understand: Knowledge growth in teaching. Educational Researcher, 15(2), 4-14.

Shulman, L. S. (in press). Knowledge and teaching: Foundations of the new reform. Teachers College Record.

Smith, B. O. (1980). A design for a school of pedagogy. Washington, DC: U. S. Department of Education.

Smith, D. C. (Ed.). (1983). Essential knowledge for beginning teachers. Washington, DC: ERIC Clearinghouse on Teacher Education.

Stark, J. S., and Lowther, M. A. (1986). Responsive professional education: Balancing outcomes and opportunities. (ASHE-ERIC Higher Education Report No. 3). Washington, DC: Association for the Study of Higher Education.

Stevens, R. (1983). Law school: Legal education in America from the 1850s to the 1980s. Chapel Hill, NC: The University of Chapel Hill Press.

Sykes, G. (1984). Teacher education and the predicament of reform. In C. E. Finn, Jr., D. Ravitch and R. T. Fancher (Eds.), Against mediocrity: The humanities in America's high schools. New York: Holmes and Meier.

Tabachnick, B. R., Popkowitz, T. S., and Zeichner, K. M. (1979-80). Teacher education and the professional perspectives of student teachers. Interchange, 10(4), 12-29.

Tabachnick, B. R., and Zeichner, K. M. (1984). The impact of student teaching experience on the development of teacher perspectives. Journal of Teacher Education, 35(6), 28-36.

Thorne, B. (1973a). Professional education in law. In E. C. Hughes (Ed.), Education for the professions of medicine, law, theology and social welfare (pp. 101-168). New York: Carnegie Foundation for the Advancement of Teaching.

Thorne, B. (1973b). Professional education in medicine. In E. C. Hughes (Ed.), Education for the professions of medicine, law, theology and social welfare (pp. 17-19). New York: Carnegie Foundation for the Advancement of Teaching.

Tversky, A., and Kahneman, D. (1982a). Availability: A heuristic for judging frequency and probability. In D. Kahneman, P. Slovic and A. Tversky (Eds.), Judgment under uncertainty: Heuristics and biases (pp. 163-173). New York: Cambridge University Press.

Tversky, A., and Kahneman, D. (1982b). Judgment under uncertainty: Heuristics and biases. In D. Kahneman, P. Slovic and A. Tversky

(Eds.), Judgment under uncertainty: Heuristics and biases (pp.3-20). New York: Cambridge University Press.

Walton, H. (1985). Overview of themes in medical education. In S. Goodlad (Ed.), Education for the professions: Quis custodiet . . .? (pp. 41-55). Guildford, England: NFER-Nelson.

Webb, C. D. (1981). Theoretical and empirical bases for early field experiences in teacher education. In C. D. Webb, N. Gehrke, P. Ishler, and A. Mendoza (Eds.), Exploratory field experiences in teacher education Reston, VA: Association of Teacher Educators.

White, James B. (1985). Doctrine in a vacuum: Reflections on what a law school ought (and ought not) to be. University of Michigan Journal of Law Reform, 18, 251-267.

White, S. (1986). Why journalism schools? The Public Interest, 82(Winter), 39-57.

Williamson, K. J., and Hudspeth, R. T. (1982). Teaching holistic thought through engineering design. Engineering Education, 72, 698-703.

Wilson, J. (1986). The teaching profession: A case of self-mutilation. Journal of Philosophy of Education, 20, 273-278.

Yinger, R. J. (1977). A study of teacher planning: Description and theory development using ethnographic and information processing methods. Unpublished doctoral dissertation, Michigan State University, East Lansing.

Yinger, R. J., and Clark, C. M. (1982). Understanding teachers' judgments about instruction: The task, the method, and the meaning (Research Series No. 121). East Lansing: Michigan State University Institute for Research on Teaching.

Zeichner, K. M. (1980). Myths and realities: Field-based experiences in preservice teacher education. Journal of Teacher Education, 32(6), 45-55.

Zimpher, N., deVoss, G. G., and Nott, D. L. (1980). A closer look at university student teacher supervision. Journal of Teacher Education, 31(4), 11-15.

Zumeta, W., and Solomon, L. C. (1982). Professions education. In H. E. Miltzel (Ed.), Encyclopedia of educational research (15th ed., pp. 1458-1467). New York: Free Press.

Zumwalt, K. K. (1982). Research on teaching: Policy implications for teacher education. In A. Lieberman and M. W. McLaughlin (Eds.), Policy making in education (81st yearbook of the National Socety for the Study of Education, Part I, pp. 215-248). Chicago: University of Chicago Press.